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| 10/707,037   | 11/17/2003  | Erica Murray         | 81044190/FMC1629PUS                     | 1036                   |
| 28395 7590 06/04/2008<br>BROOKS KUSHMAN P.C./FGTL<br>1000 TOWN CENTER<br>22ND FLOOR<br>SOUTHFIELD, MI 48075-1238 |             |                      | EXAMINER<br>ECHELMMEYER, ALIX ELIZABETH |                        |
|  |             |                      | ART UNIT<br>1795                        | PAPER NUMBER           |
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.



## DETAILED ACTION

### *Response to Amendment*

1. This Office Action is in response to the amendment filed January 10, 2008. Claims 1, 3-5, 7, 9, 12, 14-16, 18-20, 22 and 34 have been amended. Claims 1, 3-5, 7, 9-16, 18-26, 28, 30-32 and 34 are pending and are rejected finally for the reasons given below.

### *Claim Rejections - 35 USC § 112*

2. The rejections of claims 15 and 16 are withdrawn in light of the amendments.
3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claim 22 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. In the last line of the claim, it is stated that the reaction product R is directly oxidized. The disclosure provides for the reaction product *hydrogen* to be oxidized.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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6. Claim 22 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 22 recites the limitation "the reaction product R" in the last line. There is insufficient antecedent basis for this limitation in the claim; there is only antecedent basis for the reaction product *including* R.

***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1-5, 7, 9-16, 18-21 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kearl (US 6,677,070) in view of Anzai et al. (US 2003/0060364) and Nakagaki et al. (US 6,099,983).

Kearl teaches a solid oxide fuel cell that operates at a temperature from 400-800°C (column 8 lines 53-58).

With regard to claims 3 and 26, the solid oxide fuel cell may operate on methane as fuel (column 7 lines 38-47). As is discussed below, the combination of Kearl and Anzai et al. teach methane as a reformation product, which can be directly oxidized by the fuel cell of Kearl.

Regarding claims 10, 11 and 21, Kearl teaches the anode layer 18, comprises a material selected from the group consisting of nickel (Ni), Ni-yttria stabilized zirconia

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cermet (Ni-YSZ cermet), copper doped ceria, gadolinium doped ceria, strontium doped ceria, yttria doped ceria, Cu-YSZ cermet, Co-stabilized zirconia cermet, Ru-stabilized zirconia cermet, LSGM+nickel oxide, and mixtures thereof (column 6 lines 1-7).

Kearl discloses internal reforming a fuel mixture to produce hydrogen for use in the fuel cell (column 4 line 58 - column 5 line 11, specifically column 4 line 65), but fail to teach the use of the specific mixtures of the instant claims.

Anzai et al. teach reformation of fuel gas to produce hydrogen for use in fuel cells. In the method of Anzai et al., hydrocarbons and/or oxygen-containing hydrocarbons are converted to a reformed gas, which is composed principally of hydrogen by an autothermal reforming reaction using such a catalyst ([0002]).

As for claims 2 and 14 Anzai et al. disclose that the feedstock for producing a reformed gas is composed principally of hydrogen may be hydrocarbons and mixture thereof; *specific examples include dimethyl ether* ([0053]). In the process, the feed stock hydrocarbons are converted to a reformed gas composed principally of hydrogen in the presence of the catalyst by an autothermal reforming reaction.

Regarding claim 3, since the reactants of Anzai et al. and those of the instant specification are the same, the products would inherently be the same.

With regard to claims 4, 5, 15 and 16, Anzai et al. disclose the oxygen to be introduced together with the feedstock is introduced in the reformer in such an amount that the O<sub>2</sub>/carbon ratio is 0.1 to 0.5 and preferably 0.2 to 0.4 ([0052]), as defined in applicants' claim 4 and 5.

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As for claims 7, 9 and 18-20, Anzai et al. also teach that the reaction temperature is generally 200 to 800°C and preferably 300 to 600°C ([0049]). In this case, 600°C is interpreted to be “about 550°C”, as required in claim 12. Additionally, Applicant is directed to the instant specification, wherein it is disclosed that enhancements are observed at 550°C and 600°C ([0035] of instant specification, Electronic Version, 11/17/2003).

Regarding claim 12, Anzai et al. disclose reforming wherein the oxygen to carbon molar ratio is 0.33 and the reaction temperature is 600°C ([0121]).

Anzai et al. further teach that their reforming reaction suppresses the precipitation of carbon at a low steam/carbon ratio ([0008]).

It would be advantageous to use the reforming reaction of Anzai et al. with the fuel cell of Kearn because the reaction produces hydrogen, which is well known to be fuel for fuel cells, it prevents the need to transport pure hydrogen as gas to the fuel cell, and it suppresses the precipitation of carbon at a low steam/carbon ratio.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use the reforming reaction of Anzai et al. with the fuel cell of Kearn because the reaction produces hydrogen, which is well known to be fuel for fuel cells, it prevents the need to transport pure hydrogen as gas to the fuel cell, and it suppresses the precipitation of carbon at a low steam/carbon ratio.

Nakagaki et al. teach that the internal reformation of dimethyl ether for use in a fuel cell was known in the art at the time the invention was made (column 1 lines 38-51).

9. Claims 22-26, 28 and 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kearl in view of Anzai et al., Nakagaki et al. and Khandkar et al. (US 5,763,114).

Kearl teaches a solid oxide fuel cell that operates at a temperature from 400-800°C (column 8 lines 53-58). The solid oxide fuel cell operates on hydrogen as fuel, as is well known in the art and disclosed (column 4 lines 65-67).

Regarding claims 31 and 32, Kearl teaches the anode layer 18, comprises a material selected from the group consisting of nickel (Ni), Ni-yttria stabilized zirconia cermet (Ni-YSZ cermet), copper doped ceria, gadolinium doped ceria, strontium doped ceria, yttria doped ceria, Cu-YSZ cermet, Co-stabilized zirconia cermet, Ru-stabilized zirconia cermet, LSGM+nickel oxide, and mixtures thereof (column 6 lines 1-7).

Kearl discloses reforming a fuel mixture to produce hydrogen for use in the fuel cell (column 4 lines 65-66), but fail to teach the use of the specific mixtures of the instant claims.

Anzai et al. teach reformation of fuel gas to produce hydrogen for use in fuel cells. In the method of Anzai et al., hydrocarbons and/or oxygen-containing hydrocarbons are converted to a reformed gas, which is composed principally of hydrogen by an autothermal reforming reaction using such a catalyst ([0002]).

As for claims 22 and 23 Anzai et al. disclose that the feedstock for producing a reformed gas is composed principally of hydrogen may be hydrocarbons and mixture thereof; *specific examples include dimethyl ether* ([0053]). In the process, the feed stock hydrocarbons are converted to a reformed gas composed principally of hydrogen in the presence of the catalyst by an autothermal reforming reaction.

Nakagaki et al. teach that the internal reformation of dimethyl ether for use in a fuel cell was known in the art at the time the invention was made (column 1 lines 38-51).

Regarding claims 26 and 34, since the reactants of Anzai et al. and those of the instant specification are the same, the products would inherently be the same.

With regard to claims 24 and 25, Anzai et al. disclose the oxygen to be introduced together with the feedstock is introduced in the reformer in such an amount that the O<sub>2</sub>/carbon ratio is 0.1 to 0.5 and preferably 0.2 to 0.4 ([0052]), as defined in applicants' claim 4 and 5.

As for claims 28 and 30, Anzai et al. also teach that the reaction temperature is generally 200 to 800°C and preferably 300 to 600°C ([0049]). In this case, 600°C is interpreted to be "about 550°C", as required in claim 12. Additionally, Applicant is directed to the instant specification, wherein it is disclosed that enhancements are observed at 550°C and 600°C ([0035] of instant specification, Electronic Version, 11/17/2003).

Anzai et al. further teach that their reforming reaction suppresses the precipitation of carbon at a low steam/carbon ration ([0008]).



It would be advantageous to use the reforming reaction of Anzai et al. with the fuel cell of Kearl because the reaction produces hydrogen, which is well known to be fuel for fuel cells, it prevents the need to transport pure hydrogen as gas to the fuel cell, and it suppresses the precipitation of carbon at a low steam/carbon ration.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use the reforming reaction of Anzai et al. with the fuel cell of Kearl because the reaction produces hydrogen, which is well known to be fuel for fuel cells, it prevents the need to transport pure hydrogen as gas to the fuel cell, and it suppresses the precipitation of carbon at a low steam/carbon ratio.

Kearl in view of Anzai et al. fail to teach a heat source surrounding the anode and cathode of the fuel cell, the conduit and a portion of the inlet, the heat source heating the first mixture.

Khandkar et al. teach a thermally integrated reformer located inside a furnace that also houses solid oxide fuel cells. Since the reformer is within the same furnace as the fuel cells, all components linking the reformer to the fuel cells are also included within the furnace, or heat source.

Khandkar et al. further teach that, because the reformer is in the furnace, temperature gradients can be controlled, preventing excessive premature cracking in the reformer.

Additionally, the reformer is considered an inlet to the fuel cell, since it provides reactants.

It would be desirable to place the solid oxide fuel cell system of Kearl in view of Anzai et al. in a furnace such as taught by Khandkar et al., since it would prevent excessive premature cracking in the reformer by controlling temperature gradients in the fuel cell system.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to place the solid oxide fuel cell Kearl in view of Anzai et al. in a furnace such as taught by Khandkar et al., since it would prevent excessive premature cracking in the reformer by controlling temperature gradients in the fuel cell system.

### ***Response to Arguments***

10. Applicant's arguments filed January 10, 2008 have been fully considered but they are not persuasive.

Applicant argues that the combination of Kearl and Anzai et al. does not teach a thermal composition reaction, but rather teaches a reformation reaction with steam. The examiner agrees; however, the instantly filed claims do not preclude such a reaction. The claims use non-limiting language, i.e. "comprising" (see line 7 of claim 1). Additionally, beginning on the third line of claim 1, the phrase "reacting molecular oxygen and a compound ..." does not limit the claim such that steam cannot be included within the reactants. The transitional phrase "consisting of" excludes any element, step, or ingredient not specified in the claim. (See MPEP 2111.03)

Applicant also argues that Anzai et al. do not teach the claimed reaction product mixture. The examiner has asserted that the reaction product mixture is inherent. This is supported by Semelsberger et al. (Thermodynamic equilibrium ...), which teaches that products of steam reformation of dimethyl ether include methane, carbon monoxide, and hydrogen (p. 90, Table 1).

On page 10, Applicant argues that the reaction of dimethyl ether as claimed in claim 22 occurs within the SOFC. Since Kearl teaches internal reformation, the reaction occurs in an inlet of the fuel cell.

### ***Conclusion***

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alix Elizabeth Echelmeyer whose telephone number is (571)272-1101. The examiner can normally be reached on Mon-Fri 8-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Susy N. Tsang-Foster can be reached on 571-272-1293. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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